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Theory and Observations of Microbunching Instability in Electron Machines*

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Abstract

For not very short bunches, the coherent synchrotron radiation (CSR) is usually suppressed by the shielding effect of the conducting walls of the vacuum chamber. However an initial density fluctuation in the beam with a characteristic length much shorter than the bunch length can radiate coherently. If the radiation-reaction force drives growth of the initial fluctuation, one can expect an instability which leads to micro-bunching of the beam and increased coherent radiation at short wavelengths.

It has recently been realized that such an instability can play an important role in electron/positron rings where it often manifests itself as a bursting of radiation in the range of hundreds of gigahertz or terahertz. This instability can also be a source of an undesirable emittance growth in bunch compressors used in the next generation short-wavelength FELs.

In this paper, we review progress in theoretical studies and numerical simulations of the microbunching instability and show connection of the theory to recent observations in electron machines.

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